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ABSTRACT

This investigation studied the physiological profiles of eight highly trained female dance majors. To be considered highly trained, each subject had to be dancing a minimum of three hours a day, four to five days a week, for the last year. They also had to meet the criterion of dancing at least ten hours a week for the last five years prior to that year. Measurements included body composition, pulmonary function, echocardiographic analysis, and aerobic capacity. Descriptive data (age, height, weight, resting heart rate, blood pressure), pulmonary function, echocardiographic data, anthropometric data, and maximum aerobic capacity are presented in tabular form. Other test results and data are also discussed. It is concluded that dancers are subjected daily to vigorous training which taxes the cardiovascular-pulmonary system. Ballet dancers must withstand considerable work loads. In rating several sports in strength, endurance, body type, flexibility, coordination, speed, agility, balance, intelligence, and creativity, ballet received the highest rating compared with football, basketball, hockey, boxing, and baseball. (JD)

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The Physiological Profile of Trained Female Dance Majors

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The Physiological Profile of Trained Female Dance Majors

Dance has been an integral segment of life in almost every nation in the world. Throughout every race or creed, dance has symbolized the expression of a custom, tribe, or personal reflection. Dance has long been considered a part of the arts and looked at very closely from this perspective; however, when turning to the physiological nature of dance, there is very little information.

In recent years there has been an increasing call for greater involvement by researchers in the quantification of female structure and function. A review of the literature has revealed that women are more frequently being included in studies of various natures; yet, there is still a paucity of information on the physiology of dancers. It was the purpose of this investigation to study the physiological profile of eight highly trained female dance majors from Texas Woman's University.

Procedure

The subjects volunteered to take part in this study. In order to be considered highly trained, each subject had to be dancing a minimum of three hours a day,

four to five days a week, for the last year. The subjects also had to meet the criteria of dancing for the last five years prior to this, a minimum of ten hours per week. Each subject was in good health and nutritional status.

The subjects came to the motor performance laboratory dressed in shorts and a t-shirt with sneakers. After ten minutes of sitting and resting, heart rate and blood pressure were determined. Body weight was then recorded in kg within 20 g accuracy on a beam-type weighing scale. The scale was calibrated before measurements were recorded. Standing height was measured to 1 mm accuracy with a sliding anthropometer attached to the beam scale.

Pulmonary function was measured with a Simlog Instrument Medistor Analyzer and calibrated with a known quantity of gas prior to testing each dancer. Body composition was computed using the generalized regression equation of Jackson, Pollock, and Ward (1980). The skinfold sites were the triceps, supra-iliac, and thigh.

The echocardiographic analysis was performed in the Biology department at Texas Woman's University on an Irex, System II, standard M-Mode echocardiogram. A 2.25 Megahurt (MHZ) general focus transducer was used. The transducer was placed at the 3rd through 5th left peristernal interspace. All subjects were evaluated in the left lateral

decubitis position.

The assessment of maximum oxygen uptake was determined on the treadmill according to the Bruce protocol. A 72-74 Quinton treadmill was used. Before the actual test, a warm-up walk for three minutes at three miles per hour was performed by each subject. Work load was increased every three minutes by an .8 mph increase in speed and a 2 percent increase in grade until near exhaustion was reached. Heart rate was determined for the last fifteen seconds of each minute using the V_5 lead on a Quinton, Model 609, ECG monitoring system. At the end of the test, expired air was collected into a 350 liter Tissot gasometer for the last minute of work.

Concentration of oxygen and carbon dioxide in the expired air was analyzed with Applied Electrochemistry Model S-3A and Beckman Model LB-2 analyzers. Prior to testing, these instruments were calibrated with known quantities of oxygen and carbon dioxide from two separate tanks, and then compared for accuracy to two sets of Beckman analyzers from Westgate and Flo Memorial Hospitals in Denton, Texas. One dancer also completed the Bruce test twice to insure that the instruments were calibrated correctly. Several related physiological measures were used as additional criteria to verify the

attainment of Max VO_2: ventilatory volume, respiratory quotient, and maximal heart rate.

Results

The descriptive data on each subject is shown in Table 1. The mean age was 24.4 years; the mean height 164.5 cm; the mean weight 55.1 kg; the mean resting heart rate 62.7 bpm; and the mean resting blood pressure 110.1/74.5 mmHg.

The means and SD's on lung volumes are presented in Table 2. Maximum voluntary ventilation ($\dot{V}e$) was recorded at 88.1 L; vital capacity (VC) at 3.6 L; forced expiratory volume at 1 second ($FEV_{1.0}$) was 3.0 L; forced expiratory volume as a percentage of vital capacity (FEV/FVC %) was averaged at 84%; and maximal voluntary ventilation was valued at 99.8 L.

The means and standard deviations of the echocardiographic analysis have been presented in Table 3. The major values that should be reiterated here are: IVS-7.3mm, LVWT-7.1mm, $LVID_d$-46.1mm, $LVID_s$-30.5mm, and SV-68.5ml.

The results of the anthropometric measurements and maximum oxygen uptake are shown in Tables 4 and 5 respectively. The average value of percent body fat was 20.1%,

TABLE 1

DESCRIPTIVE DATA

SUBJECT	AGE	HEIGHT (CM)	WEIGHT (KG)	RESTING H.R. (BPM)	BLOOD PRESSURE (SYS)	(DIAS)
1	26	174	53.5	65	110	60
2	32	152	47.0	67	103	78
3	26	160	45.5	47	103	73
4	21	156	54.0	67	120	80
5	25	168	58.0	73	116	80
6	18	168	64.0	68	120	80
7	20	168	60.5	57	105	70
8	27	170	58.5	57	110	70
$\bar{X}$	24.4	164.5	55.1	62.7	110.1	74.5
S	04.5	07.6	06.4	08.3	07.1	07.2

TABLE 2

PULMONARY FUNCTION

SUBJECT	$\dot{V}_E$	VC	$FEV_{1.0}$	FEV/FVC %	MVV
1	80.7	3.90	3.37	86.5	095.4
2	84.6	2.87	2.37	83.0	079.8
3	75.5	3.37	2.96	88.6	100.8
4	92.7	3.23	2.64	82.2	091.8
5	105.8	4.31	3.69	86.0	139.2
6	87.2	3.72	2.66	71.7	062.4
7	88.8	3.85	3.15	85.0	113.3
8	90.1	3.67	3.34	91.8	115.8
$\bar{X}$	88.1	3.60	3.00	84.0	099.8
S	09.0	0.45	0.44	05.9	23.5

* $\dot{V}_E$ IS THE MAXIMUM VENTILATORY CAPACITY (BTPS) DURING THE TREADMILL TESTING.

TABLE 3

ECHOCARDIOGRAPHIC DATA

SUBJECT	LAD	$RVID_D$	IVS	LVWT	$LVID_D$	$LVID_S$	SV
1	22	18	8	8	48	32	77.8
2	30	12	7	7	42	27	49.7
3	26	16	9	8	43	22	68.9
4	33	13	7	7	43	27	59.3
5	26	28	6	6	48	35	67.7
6	34	28	8	8	50	34	85.7
7	35	23	6	6	49	36	71.0
8	33	15	7	7	46	31	67.6
$\bar{X}$	29.9	19.1	7.3	7.1	46.1	30.5	68.5
S	4.7	6.4	1.0	0.83	3.0	4.3	10.7

LAD = LEFT ATRIAL DIAMETER; $RVID_D$ = RIGHT VENTRICULAR INTERNAL DIMENSION AT END-DIASTOLE; IVS = INTERVENTRICULAR SEPTAL THICKNESS; LVWT = LEFT VENTRICULAR POSTERIOR WALL THICKNESS; $LVID_D$ = LEFT VENTRICULAR INTERNAL DIMENSION AT END-DIASTOLE; $LVID_S$ = LEFT VENTRICULAR INTERNAL DIMENSION AT END-SYSTOLE; SV = STROKE VOLUME.

* ALL VALUES ARE IN MM EXCEPT FOR STROKE VOLUME WHICH IS IN ML.

TABLE 4

ANTHROPOMETRIC DATA

SUBJECT	AGE	TRICEP	THIGH	SUPRA-ILIAC	BD	% FAT
1	26	18.5	23.5	12.5	1.04859	22.0
2	32	19.5	23.5	12.5	1.04739	22.6
3	26	06.5	16.0	04.6	1.07074	12.3
4	21	15.5	31.0	14.5	1.04412	23.9
5	25	11.5	17.5	08.5	1.06201	16.0
6	18	17.0	22.0	11.0	1.04745	22.5
7	20	17.0	25.5	19.0	1.04434	23.9
8	27	11.0	21.0	11.0	1.05785	17.9
$\bar{X}$	24.4	14.6	22.5	11.7	1.05284	20.1
S	04.5	04.5	04.7	04.2	0.00970	04.2

TABLE 5

MAXIMUM AEROBIC CAPACITY

SUBJECT	MAX VO_2 L/MIN	MAX VO_2 ML/KG/MIN	MAX H.R. (BPM)
1	2.8	50.4	199
2	2.6	52.0	195
3	2.4	49.9	195
4	3.1	55.2	192
5	3.3	55.4	195
6	3.4	50.0	198
7	3.3	51.2	190
8	3.2	55.3	190
$\bar{X}$	3.0	52.4	194.3
S	0.4	02.7	03.4

while the mean value for Max VO_2 was 52.4 ml/kg/min.

Discussion

The data that were obtained in this study were compared to studies reported in the literature on female athletes and dancers.

The average height and weight of the dancers in this study was 164.5 cm and 55.1 kg, respectively. Cohen et al. (1980) found a mean value of 165.4 cm for height and 49.6 kg for weight on 12 professional female dancers from the American Ballet Theater in New York City. Dolgener et al. (1980) found mean values of 164.0 cm for height and 52.5 kg for weight on 19 professional female dancers from the Cincinnati Ballet and Modern Dance Company in Cincinnati. The three studies are in close agreement on average height and in fairly close agreement on weight.

Comparing the results of the pulmonary function analysis with a study done by Astrand on the Stockholm Opera Ballet, the values for maximal pulmonary ventilation were very close; 88.1 L/min and 87.4 L/min, respectively (Astrand, 1973). Wigaeus and Kilbom (1980) found a value of 94.7 L/min on 6 Swedish folk dancers. Plowman (1974) in a review of the literature found values of 85.0 L/min. for champion gymnasts and track athletes. The values of the dancers for vital capacity, forced expiratory volume

in the first second, and maximal voluntary ventilation were slightly above average compared to the tables and nomograms of Gaensler and Wright using the subject's height, weight, and body surface area (1966).

The echocardiographic data of this study were compared to the data of Cohen et al. (1980) on the American Ballet Theater dancers and were also compared to a control group. The major differences between the three groups were in Interventricular Septal Thickness (IVS), Left Ventricular Posterior Wall Thickness (LVWT), Left Ventricular Internal Dimension at End-Diastole ($LVID_d$), and Stroke Volume (SV). Cohen's dancers had a menn value of 9.7 mm while the control group was 8.0 mm and the present study found a value of 7.3 mm on IVS. LVWT was also higher in Cohen's dancers and the control group, 10.9 mm and 9.7 mm respectively, compared to 7.1 mm of the present study.

On the dimensions of $LVID_d$ and SV, the dancers of this study were higher than Cohen's professional dancers and the control group. $LVID_d$ was 46.1 mm for the present study compared to 43.1 mm on Cohen's dancers and 41.0 mm on the control group. Stroke Volume (SV) was 68.5 ml for the present study compared to 57.2 ml for Cohen's dancers and 46.0 ml for the control group.

Percent body fat was found to be almost identical to three other studies on dancers reported by Novak et al., (1978), Dolgener et al. (1980), and Rosentswieg (1979). The present study found a mean value of 20.1% while Novak et al. on 12 dance majors from Southern Methodist University found a value of 20.5%, Dolgener et al. on the Cincinnati Ballet Company found a value of 22.1%, and Rosentswieg et al. on professional dancers found a value of 21.1%. These values were lower than for normal values on college-aged females of 25.6% as reported by Katch and McArdle (1977).

In the final analysis of maximum aerobic capacity, the mean maximal heart rate of 194.3 bpm agrees with the data reported on by Plowman (1974) on 300 female champion and school athletes in swimming, track, skating, skiing, and basketball. The comparison of the Max VO_2 of the dancers in this study ($\bar{X}$ = 52.4 ml/kg/min) to champion athletes has been found to be lower than values obtained on cross-country skiers of 58 ml/kg/min, and long distance runners and sprinters of 60 ml/kg/min; equal to those of champion swimmers, speed and figure skaters of 52 ml/kg/min, and higher than champion gymnasts of 43 ml/kg/min.

The results of the Max VO_2 of the present study

are in agreement with Astrand's study on 6 members of the Stockholm Opera Ballet where he found a mean value of 48 ml/kg/min with the highest value at 56 ml/kg/min.

The highest recorded value on a female dancer was Jackie Sorenson, female professional dancer and innovator of "aerobic dancing". She was tested by Zohman and Phillips (1973) and was found to have a Max VO_2 of 70 ml/kg/min at the age of 29 years.

In accordance with the Cooper Classification Chart (1977) and the American Heart Association Cardiorespiratory Fitness Classification Chart (1972), the dancers in this study were in excellent cardiovascular condition.

Conclusion

There is a paucity of research on the physiology of dancers. The information that is available has shown that dancers are subjected daily to vigorous training of several hours which taxes the cardiovascular-pulmonary system. Large muscle groups are involved in various movements with fluctuating speeds. According to two studies by Astrand (1973) and Seliger et al. (1970), the work load of dance instruction could be quantified from moderate to heavy. Novak et al. (1978) mention that ballet dancers must withstand considerable loads of endurance character.

De Guzman (1979) notes that when Dr. James Nicholas, orthopedic surgeon at the Institute of Sports Medicine and Athletic Training, Lenox Hill Hospital, New York City, was asked to rate several sports in strength, endurance, body type, flexibility, coordination, speed, agility, balance, intelligence, and creativity, ballet received the highest rating compared with 23 points for football, basketball, hockey, and boxing and only 15 points for baseball. This fact was supported by Nicholas' colleagues.

The eight dancers in this study can be considered highly trained aerobic athletes. The average amount of time that each dancer spent in dance activity was between 4-5 hours daily. Due to the small sample size and lack of a control group, statistical significance was not determined. The major emphasis of this study was to scrutinize the physiological profile of dancers and to encourage other researchers to explore the "world" of dance. We have yet to fully examine the ultimate potential of the elite dancer.

References

American Heart Association. Exercise testing and training of apparently healthy individuals: a handbook for physicians. Dallas, Texas, 1972.

Astrand, P.O. Work requirement demands in conjunction with ballet. Karolinska Institute: Stockholm, Sweden, 1973.

Cohen, J.L.; Gupta, P.K.; Lichstein, E.; and Chadda, K.D. The heart of a dancer: noninvasive cardiac evaluation of professional ballet dancers. American Journal of Cardiology, 1980, 45, 959-965.

Cooper, K.H. The aerobics way. New York: M. Evans and Co., 1977.

De Guzman, J.A. Dance as a contributor to cardiovascular fitness and alteration of body composition. Journal of Physical Education and Recreation, 1979, 50, 88-91.

Dolgener, F.A.; Spasoff, T.C.; and St. John, W.E. Research Quarterly For Exercise and Sport, 1980, 51, 599-607.

Gaensler, E. A. and Wright, G.W. Evaluation of respiratory impairment. Archives of Environmental Health, 1966, 12, 146-189.

Jackson, A.S.; Pollock, M.L.; and Ward, A. Generalized equations for predicting body density of women. Medicine and Science in Sports and Exercise, 1980, 12, 175-182.

Katch, F.I. and McArdle, W.D. Nutrition, weight control, and exercise. Boston: Houghton Mifflin Co. , 1977.

Novak, L.P.; Magill, L.A.; and Schutte, J.E. Maximal oxygen intake and body composition of female dancers. European Journal of Applied Physiology, 1978, 39, 277-282.

Plowman, S. Physiological characteristics of female athletes. Research Quarterly, 1974, 45, 349-362.

Rosentswieg, J.; Tate, J. and Fuller, P. Body composition specificity of female dancers (Abstract). Medicine and Science in Sports and Exercise, 1979, 11, 102-103.

Seliger, V.; Glucksmann, J.; Pachlopnik, J; and Pachlopnikova. Int. Z. angew Physiol. 1970, 28, 86-104.

Wigaeus, E. and Kilbom, A. Physical demands during folk dancing. European Journal of Applied Physiology, 1980, 45, 177-183.

Zohman, L.R. and Phillips, R.E. Medical aspects of exercise and training. New York: Intercontinental Book Corporation, 1973.